Curriculum changes to ECE Programs (EE, CPE, CCSE)

February 2022

The ECE Department recently approved curriculum changes for all three undergraduate degree programs (B.S. in Electrical Engineering; B.S. in Computer Engineering and B.S. in Computer and Cybersecurity Engineering). The objective of this curriculum update is to create program flexibility with a balance between wider breadth of knowledge and strong foundation in core areas while providing a personalized learning experience for students consistent with their interest and potential.

This proposal introduces "Career Elective" courses in multiple semesters (four in EE, three in CPE and two in CCSE). A career elective course is defined as "an advisor-approved course from engineering, science, math, computer science, business, and law that is more advanced than the academic level of the student"

The following document includes the summary of changes, current and revised curriculum sample sheets for all three programs. Additional documents include curriculum guidelines for reference and the history of the ECE program changes.

Objectives:

- Position our students to be competitive in research and industry careers by
    - creating program flexibility and program tracks with a balance between wider breadth of knowledge and strong foundation in core areas;
    - providing an effective learning experience to students consistent with their interest and potential;
    - upgrading our undergraduate program consistent with advances in Electrical and Computer Engineering and being more competitive with peer universities in a timely fashion.
- Position our undergraduate program as an attractive one for incoming students.
    - Maximize flexibility for transfer students and flexibility to pursue co-curricular and extra-curricular activities, co-terminal and interdisciplinary masters, etc. Minimize pre- and co-requisite requirements where possible.

Restructuring Highlights

- Career Electives I, II, III and IV in Freshman, Sophomore, Junior and Senior years create opportunities for options for minors, increased emphasis within major tracks, and depth and breadth across technical disciplines.
- Remove specific course requirements that are less relevant to today's ECE work and replace with more flexible options.
    - MMAE 200/320, Science Elective, Physics III are replaced by Career Electives

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Attachment I: Current Bachelor of Science in Electrical Engineering (BSEE) Curriculum

First Semester		Term Taken	Grade
MATH 151 Calculus I	5		
CHEM 122 Prin. Chem. I	3		
CS 115 Object-Oriented Prgm I	2		
ECE 100 Intro. to the Profession	3		
HUM 200,202,204,206 or 208	3		
TOTAL	**16**		

Second Semester		Term Taken	Grade
MATH 152 Calculus II	5		
PHYS 123 Mechanics	4		
BIOL 105, BIOL 114,CHEM 126 or MS 201	3		
CS 116 Object-Oriented Prgm II	2		
Soc Sci Elect	3		
TOTAL	**17**		

Third Semester		Term Taken	Grade
MATH 252 Intro. Diff. Eq.	4		
PHYS 221 Electromag. & Optics	4		
ECE 211 Ckt. Analysis I	3		
ECE 218 Digital Systems	4		
TOTAL	**15**		

Fourth Semester		Term Taken	Grade
MATH 251 Multivariate Calculus	4		
PHYS 224 Thm. & Modern Phys.	3		
ECE 213 Ckt. Analysis II	4		
ECE 242 Dig. Comp./Comptg.	3		
Soc Sci Elect	3		
TOTAL	**17**		

Fifth Semester		Term Taken	Grade
MATH 333 Matrices	3		
IPRO I	3		
ECE 307 Electrodynamics	4		
ECE 311 Engineering Electronics	4		
Humanities Elect 300-level or above	3		
TOTAL	**17**		

Sixth Semester		Term Taken	Grade
ECE 308 Signals & Systems	3		
ECE 319 Fund. Power Engineering	4		
MATH 374 Probability/Statistics for ECE	3		
Soc Sci Elect	3		
Free Elective	3		
TOTAL	**16**		

Seventh Semester		Term Taken	Grade
IPRO II	3		
Professional ECE Elective	4		
Professional ECE Elective	3-4		
Technical Elective	3		
Humanities Elect 300-level or above	3		
TOTAL	**16-17**		

Eighth Semester		Term Taken	Grade
Major Design Exp. (M) Elective Course	4		
Professional ECE Elective	3-4		
Professional ECE Elective	3-4		
MMAE 200 or 320	3		
Additional Hum. or Soc. Sci. Elective	3		
TOTAL	**16-18**		

Total Credits (BSEE): 130-133

Attachment II: BSEE Restructure Highlights

Enumerated list of proposed program adjustments for the BSEE program. The curriculum changes are highlighted

1. In sem. 2, replace science elective (BIOL 105, 114, CHEM 126, MS 201) with CAREER ELECTIVE I.
2. In sem. 4, replace PHYS 224 with CAREER ELECTIVE II.
3. In sem. 6, CAREER ELECTIVE III replaces Free Elective.
4. In sem. 7, Free Elective replaces Technical Elective.
5. In sem. 8, replace MMAE200/MMAE320 with CAREER ELECTIVE IV.

Career Electives: Advisor-approved course from engineering, science, math, computer science, business, and law that is more advanced than the academic level of the student.

Career Elective II: 200-level or above
Career Elective III: 300-level or above
Career Elective IV: 400-level

Attachment III: New Bachelor of Science in Electrical Engineering Curriculum

First Semester		Term Taken	Grade
MATH 151 Calculus I	5		
CHEM 122 Prin. Chem. I	3		
CS 115 Object-Oriented Prgm I	2		
ECE 100 Intro. to the Profession	3		
HUM 200,202,204,206 or 208	3		
TOTAL	**16**		

Second Semester		Term Taken	Grade
MATH 152 Calculus II	5		
PHYS 123 Mechanics	4		
Career Elective I[1]	3		
CS 116 Object-Oriented Prgm II	2		
Soc Sci Elect [5]	3		
TOTAL	**17**		

Third Semester		Term Taken	Grade
MATH 252 Intro. Diff. Eq.	4		
PHYS 221 Electromag. & Optics	4		
ECE 211 Ckt. Analysis I	3		
ECE 218 Digital Systems	4		
TOTAL	**15**		

Fourth Semester		Term Taken	Grade
MATH 251 Multivariate Calculus	4		
Career Elective II	3		
ECE 213 Ckt. Analysis II	4		
ECE 242 Dig. Comp./Comptg.	3		
Soc Sci Elect [5]	3		
TOTAL	**17**		

Fifth Semester		Term Taken	Grade
MATH 333 Matrices	3		
IPRO I	3		
ECE 307 Electrodynamics	4		
ECE 311 Engineering Electronics	4		
Humanities Elect (300+) [6]	3		
TOTAL	**17**		

Sixth Semester		Term Taken	Grade
ECE 308 Signals & Systems	3		
ECE 319 Fund. Power Engineering	4		
MATH 374 Probability/Statistics for ECE	3		
Soc Sci Elect [5]	3		
Career Elective III	3		
TOTAL	**16**		

Seventh Semester		Term Taken	Grade
IPRO II	3		
Professional ECE Elective [2]	4		
Professional ECE Elective	3-4		
Free Elective [3]	3		
Humanities Elective (300+) [6]	3		
TOTAL	**16-17**		

Eighth Semester		Term Taken	Grade
Major Design Exp. (M) Elective Course [4]	4		
Professional ECE Elective	3-4		
Professional ECE Elective	3-4		
Career Elective IV	3		
Additional Hum. or Soc. Sci. Elective [7]	3		
TOTAL	**16-18**		

Total Credits (BSEE): 130-133

Attachment IV: Current Bachelor of Science in Computer Engineering (BSCPE) Curriculum

First Semester		Term Taken	Grade
MATH 151 Calculus I	5		
CHEM 122 Prin. Chem. I	3		
CS 115 Object-Oriented Prgm I	2		
ECE 100 Intro. To the Profession	3		
HUM 200, 202,204,206, or 208	3		
TOTAL	**16**		

Second Semester		Term Taken	Grade
MATH 152 Calculus II	5		
PHYS 123 Mechanics	4		
BIOL 105, BIOL 114 or CHEM 126, or MS 201	3		
CS 116 Object-Oriented Prgm II	2		
Soc Sci Elective	3		
TOTAL	**17**		

Third Semester		Term Taken	Grade
MATH 252 Differential Eqns.	4		
PHYS 221 EM & Optics	4		
ECE 211 Ckt. Analysis I	3		
ECE 218 Digital Systems	4		
CS 331 Data Structures & Alg.	3		
TOTAL	**18**		

Fourth Semester		Term Taken	Grade
MATH 251 Multivariate Calculus	4		
PHYS 224 Thm. & Modern Phys.	3		
ECE 213 Ckt. Analysis II	4		
ECE 242 Dig.Comp./Comptg. Computer	3		
CS 330 Discrete Structures	3		
TOTAL	**17**		

Fifth Semester		Term Taken	Grade
MMAE 200 or 320 Mech or Thermo	3		
ECE 311 Engineering Electronics	4		
CS 351 Systems Programming	3		
MATH 333 or MATH 350	3		
Humanities Elective (300+)	3		
TOTAL	**16**		

Sixth Semester		Term Taken	Grade
Junior CPE Elective	3-4		
CS 450 Operating Systems	3		
MATH 374 Probability/Stat. for ECE	3		
IPRO I	3		
Soc Sci Elective	3		
TOTAL	**15-16**		

Seventh Semester		Term Taken	Grade
ECE 485 Comp. Arch. & Org.	3		
Computer Systems/Software Elective	3-4		
Professional CPE Elective	3-4		
Professional CPE Elective	3-4		
Humanities or Soc. Sci. Elective	3		
TOTAL	**15-18**		

Eighth Semester		Term Taken	Grade
ECE 441 Smart and Connected Emb. Sys.	4		
ECE 429 or ECE 446	4		
IPRO II	3		
Humanities Elective (300+)	3		
Soc Sci Elective	3		
TOTAL	**17**		

Total Credits (BSCE) 131-135

Attachment V: BSCPE Restructure Highlights

Enumerated list of proposed program adjustments for the BSCPE program. The curriculum changes are highlighted.

1. In sem. 2, replace science elective (BIOL 105, 114, CHEM 126, MS 201) with CAREER ELECTIVE I.
2. In sem. 4, replace PHYS 224 with CAREER ELECTIVE II.
3. In sem. 5, replace MMAE 200/320 with CAREER ELECTIVE III and move it to sem. 6.
4. IPRO I moved from sem. 6 to 5.
5. ECE 429 or ECE 446 moved from sem. 8 to sem. 7.
6. One of the Prof. CPE electives is moved from sem. 7 to sem. 8.

Career Electives: Advisor-approved course from engineering, science, math, computer science, business, and law that is more advanced than the academic level of the student.

Career Elective II: 200-level or above
Career Elective III: 300-level or above

Attachment VI: New Bachelor of Science in Computer Engineering Curriculum

First Semester		Term Taken	Grade
MATH 151 Calculus I	5		
CHEM 122 Prin. Chem. I	3		
CS 115 Object-Oriented Prgm I	2		
ECE 100 Intro. To the Profession	3		
HUM 200, 202,204,206, or 208	3		
TOTAL	**16**		

Second Semester		Term Taken	Grade
MATH 152 Calculus II	5		
PHYS 123 Mechanics	4		
Career Elective I [1]	3		
CS 116 Object-Oriented Prgm II	2		
Soc Sci Elective	3		
TOTAL	**17**		

Third Semester		Term Taken	Grade
MATH 252 Differential Eqns.	4		
PHYS 221 EM & Optics	4		
ECE 211 Ckt. Analysis I	3		
ECE 218 Digital Systems	4		
CS 331 Data Structures & Alg.	3		
TOTAL	**18**		

Fourth Semester		Term Taken	Grade
MATH 251 Multivariate Calculus	4		
Career Elective II	3		
ECE 213 Ckt. Analysis II	4		
ECE 242 Dig.Comp.	3		
CS 330 Discrete Structures	3		
TOTAL	**17**		

Fifth Semester		Term Taken	Grade
IPRO I	3		
ECE 311 Engineering Electronics	4		
CS 351 Systems Programming	3		
MATH 333 or MATH 350	3		
Humanities Elective (300+) [6]	3		
TOTAL	**16**		

Sixth Semester		Term Taken	Grade
Junior CPE Elective [8]	3-4		
CS 450 Operating Systems	3		
MATH 374 Probability/Stat. for ECE	3		
Career Elective III	3		
Soc Sci Elective [5]	3		
TOTAL	**15-16**		

Seventh Semester		Term Taken	Grade
ECE 485 Comp. Arch. & Org.	3		
Computer Systems/Software Elective	3-4		
ECE 429 or ECE 446	4		
Professional CPE Elective [9]	3-4		
Humanities Elective (300+) [6]	3		
TOTAL	**16-18**		

Eighth Semester		Term Taken	Grade
ECE 441 Smart and Connected Emb. Sys. [4]	4		
Professional CPE Elective [9]	3-4		
IPRO II	3		
Additional Humanities or Soc. Sci. Elective [7]	3		
Soc Sci Elective [5]	3		
TOTAL	**16-17**		

Total Credits (BSCE) 131-135

Attachment VII: Current Computer and Cybersecurity (BSCCSE) Curriculum

First Semester			Term Taken	Grade
MATH 151 Calculus I		5		
CHEM 122 Prin. Chem. I		3		
CS 115 Object-Oriented Prgm I		2		
ECE 100 Intro. to the Profession I		3		
HUM 200,202,204,206 or 208		3		
TOTAL		**16**		

Second Semester		Term Taken	Grade
MATH 152 Calculus II	5		
PHYS 123 Mechanics	4		
BIOL 105, BIOL 114 or CHEM 126 or MS 201	3		
CS 116 Object-Oriented Prgm II	2		
Soc Sci Elect [7]	3		
TOTAL	**17**		

Third Semester			Term Taken	Grade
MATH 252 Differential Eqns.		4		
PHYS 221 EM & Optics		4		
ECE 211 Ckt. Analysis I		3		
ECE 218 Digital Systems		4		
CS 331 Data Structures & Alg.		3		
TOTAL		**18**		

Fourth Semester		Term Taken	Grade
MATH 251 Multivariate Calculus	4		
PHYS 224 Thm. & Modern Phys.	3		
ECE 213 Ckt. Analysis II	4		
ECE 242 Dig. Comp. & Comptg.	3		
CS 330 Discrete Structures	3		
TOTAL	**17**		

Fifth Semester			Term Taken	Grade
ECE 308 Signals Systems		3		
ECE 311 Engineering Electronics		4		
CS 351 Systems Programming		3		
MATH 333 Mat.Alg. & Complx.Vars.		3		
Humanities Elective (300+)		3		
TOTAL		**16**		

Sixth Semester		Term Taken	Grade
ECE 407 Intro. to Comp Ntwks	4		
CS 450 Operating Systems	3		
MATH 374 Probability/Stat. for ECE	3		
IPRO I	3		
Soc Sci Elective	3		
TOTAL	**16**		

Seventh Semester			Term Taken	Grade
ECE 497 Special. Prob. on Cyber Security		3		
ECE 485 Comp. Arch. & Org.		3		
ECE 443 Intro. to Computer Security		3		
IPRO II		3		
Hum. or Soc. Sci. El.		3		
Soc Sci Elective		3		
TOTAL		**18**		

Eighth Semester		Term Taken	Grade
ECE 441 Smart & Connected Emb. Sys.	4		
ECE 442 IoT & Cyber Physical Sys.	3		
ECE 444 Computer Network Security	3		
Cyber Security Law Elective	2-3		
Humanities Elective (300+)	3		
TOTAL	**15-16**		

Total Credits (BSCCSE): 133-134

Attachment VIII: BSCCSE Restructure Highlights

Enumerated list of proposed program adjustments for the BSCCSE program. The curriculum changes are highlighted.

1. In sem. 2, replace science elective (BIOL 105, 114, CHEM 126, MS 201) with CAREER ELECTIVE I.
2. In sem. 4, replace PHYS 224 with CAREER ELECTIVE II. (Note: A new 200-level Cybersecurity course under development)
3. ECE 443 moved from sem. 7 to sem. 6.
4. MATH374 moved from sem. 6 to sem. 7.

Career Electives: Advisor-approved course from engineering, science, math, computer science, business, and law that is more advanced than the academic level of the student.

Career Elective II: 200-level or above

Attachment IX: New Bachelor of Science in Computer and Cybersecurity Engineering Curriculum

First Semester		Term Taken	Grade
MATH 151 Calculus I	5		
CHEM 122 Prin. Chem. I	3		
CS 115 Object-Oriented Prgm I	2		
ECE 100 Intro. to the Profession I	3		
HUM 200,202,204,206 or 208	3		
TOTAL	**16**		

Second Semester		Term Taken	Grade
MATH 152 Calculus II	5		
PHYS 123 Mechanics	4		
Career Elective I [1]	3		
CS 116 Object-Oriented Prgm II	2		
Soc Sci Elect [5]	3		
TOTAL	**17**		

Third Semester		Term Taken	Grade
MATH 252 Differential Eqns.	4		
PHYS 221 EM & Optics	4		
ECE 211 Ckt. Analysis I	3		
ECE 218 Digital Systems	4		
CS 331 Data Structures & Alg.	3		
TOTAL	**18**		

Fourth Semester		Term Taken	Grade
MATH 251 Multivariate Calculus	4		
Career Elective II	3		
ECE 213 Ckt. Analysis II	4		
ECE 242 Dig. Comp. & Comptg.	3		
CS 330 Discrete Structures	3		
TOTAL	**17**		

Fifth Semester		Term Taken	Grade
ECE 308 Signals Systems	3		
ECE 311 Engineering Electronics	4		
CS 351 Systems Programming	3		
MATH 333 or MATH 350	3		
Humanities Elective (300+) [6]	3		
TOTAL	**16**		

Sixth Semester		Term Taken	Grade
ECE 407 Intro. to Comp Ntwks	4		
CS 450 Operating Systems	3		
ECE 443 Intro. to Computer Security	3		
IPRO I	3		
Soc Sci Elective [5]	3		
TOTAL	**16**		

Seventh Semester		Term Taken	Grade
ECE 497 Special. Prob. on Cyber Security	3		
ECE 485 Comp. Arch. & Org.	3		
MATH 374 Probability/Stat. for ECE	3		
IPRO II	3		
Humanities Elective (300+) [6]	3		
Soc Sci Elective [5]	3		
TOTAL	**18**		

Eighth Semester		Term Taken	Grade
ECE 441 Smart & Connected Emb. Sys.[4]	4		
ECE 442 IoT & Cyber Physical Sys.	3		
ECE 444 Computer Network Security	3		
Cyber Security Law Elective [9]	2-3		
Additional Hum. or Soc. Sci. El. [7]	3		
TOTAL	**15-16**		

Total Credits (BSCCSE): 133-134

Attachment X: Definitions of Electives

[1]**Career Electives:** Advisor-approved course from engineering, science, math, computer science, business, and law that is more advanced than the academic level of the student.

[2]**Professional ECE Elective**: Any of the 400-level ECE courses identified with a (P) in the course descriptions and/or 500-level with the written consent of the instructor.

[3]**Free Elective:** Advisor approved course from any field of interest to the student.

[4]At least one of the professional ECE elective courses must be identified as a Major Design Experience (M) course. Note: ECE 441 is an (M) course.

[5]**Social Science Elective:** ECON, PS, PSYC, SOC or SSCI course with (SOC) in course description. Distribution of courses must be from at least two different fields; at least 6 credit hours at 300 level.

[6]**Humanities elective:** AAH, COM, HIST, HUM, LIT, PHIL course with an (HUM) in the course description at 300 level or above.

[7]**Humanities and Social Science Elective:** ECON, PS, PSYC, SOC, SSCI, AAH, COM, HIST, HUM, LIT, PHIL course with an (H) or (S) in course description.

[8]**Junior CPE elective**: Choose one of ECE 307, ECE 308, or ECE 319.

[9]**Professional CPE Elective:** ECE 4xx with (**P**) except ECE 448 or any CS 4xx except CS 485. A maximum of 3 credit hours of ECE 491, or ECE 497.

[10] **Law elective:** Choose from the following courses: LAW 252, LAW 285, LAW 295, or LAW 478.

Attachment XI: Guidelines and Audits

Core Curriculum and ABET Guidelines

- Minimum of 126 credits in each program.
- Minimum 45 credits in major/engineering (ABET).
- Minimum of 30 credits for Mathematics and Sciences (ABET)
- General Education: 9 credits in Humanities + 9 credits in Social Sciences + 3 credits in Humanities or Social Science
- Two IPRO's

Commonality between the three programs

- Keep Freshman and Sophomore year course offerings and sequencing consistent
- Key common courses e.g., ECE 100 same semester; career electives I and II in same semesters for EE, CE, and CCSE; career elective III in the same semester for EE and CE.
- Humanities in semesters 1, 5, and 7; Humanities or Social Science in semester 8

Appendix XII: Program Changes to the ECE Programs (since 2018)

02/09/2021

Information Item:

Update for the ECE Curriculum

ABET has reported a shortcoming in the Criteria 5 (Curriculum) with respect to "culminating major engineering design" for both EE and CPE programs. ECE department meets this requirement through two elective laboratory design courses with senior design projects. ABET audit summary reports that "Program lab courses, either individually or collectively, is not culmination of years of student learning and experience."

Based on the feedback received from ABET, ECE Department has decided to designate one of the senior professional elective courses required as a Major Design Experience (M) course. Major Design Experience courses are designed to meet the ABET requirements (see below).

Curriculum change for ECE Programs (EE, CPE and CCSE)

> Professional ECE electives may be chosen from any of the 400-level ECE courses identified with (P) in the course descriptions. At least two of the electives must contain laboratories. At least one of the elective courses must be identified as Major Design Experience (M) course.

Revised ECE441 Course designated as a Major Design Experience (M) course:

> ECE441 is now a 100% project-based course with students working in teams on implementation of a smart and connected system targeting different application domains. Restructured ECE441 schedule include several project milestones that need to be met by students including project proposal, midterm progress reports, final report and presentations

11/24/2020

Information item:

All ECE 400-level courses are to be denoted as Professional Electives and designated as such by the addition of the letter (P) in the bulletin. This formalizes an existing practice within ECE.

09/25/2018

Program changes to BS EE

Consolidation of *ECE 211 Circuit Analysis I*, *ECE 213 Circuit Analysis II*, *ECE 311 Engineering Electronics*, and *ECE 312 Electronics Circuits* is part of an effort by the ECE to restructure our BS curricula to position our students to be competitive in research and industry careers by

- creating program flexibility and program tracks with a balance between wider breadth of knowledge and strong foundation in core areas;
- providing an effective learning experience to students consistent with their interest and potential; and
- upgrading our undergraduate program consistent with advances in Electrical and Computer Engineering and being more competitive with peer universities in a timely fashion.

In short, changes are as follows:

- **ECE 211, ECE 213, and ECE 311 course contents are revised to remove any redundancy and cover the important topics from ECE 312.**
- **ECE 312 (4 hours) was therefore eliminated in the BS EE and is now replaced by a Free Elective (3 hours).**
- The range of total credit hours is thus reduced from 131-134 to 130-133.

A vote to accept the change to the program was taken and motion passed, 16 to 0

A vote to accept this as a minor change was taken and motion passed, 16 to 0